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(54) Configuring functional units in a serial master-slave arrangement

(57) Several slave units 1, 2 of a master-salve configuration are connected in series, the slave units 1, 2 are each equipped with two pairs of input/output units and with a digital computer 10, 11, an electronic switch 25, 26 being provided between a receiving unit 16, 19 located in a direction coming from the master unit 6 and a neighbouring slave unit 2 being more remote from said master unit 6, the control input 27, 28 of said electronic switch being connected to the digital computer 10, 11. In each slave unit 1, 2 there is provided an electronic signal-summing element 29, 30, a first input of said signal-summing element being connected to the digital computer 10, 11, preferably via an interface circuit, and a second input of said signal-summing element being connected to a receiving section 17, 19 of the input/output unit receiving signals from said neighbouring slave unit provided more remote from the master unit 6.
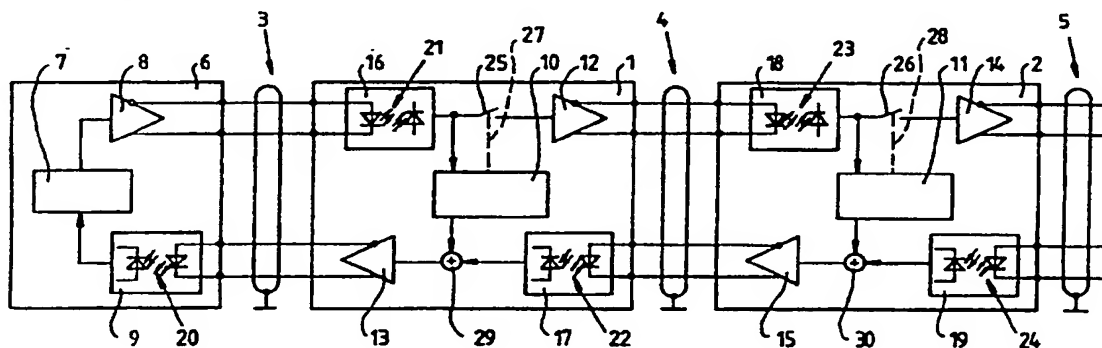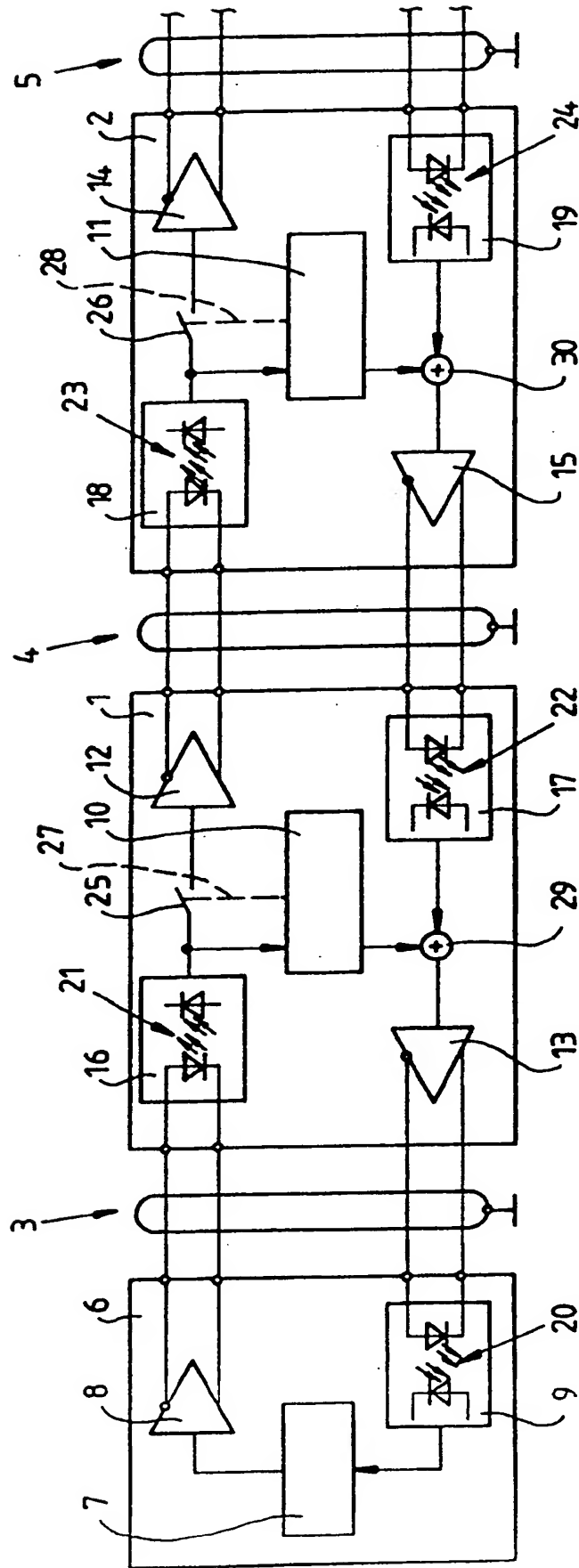
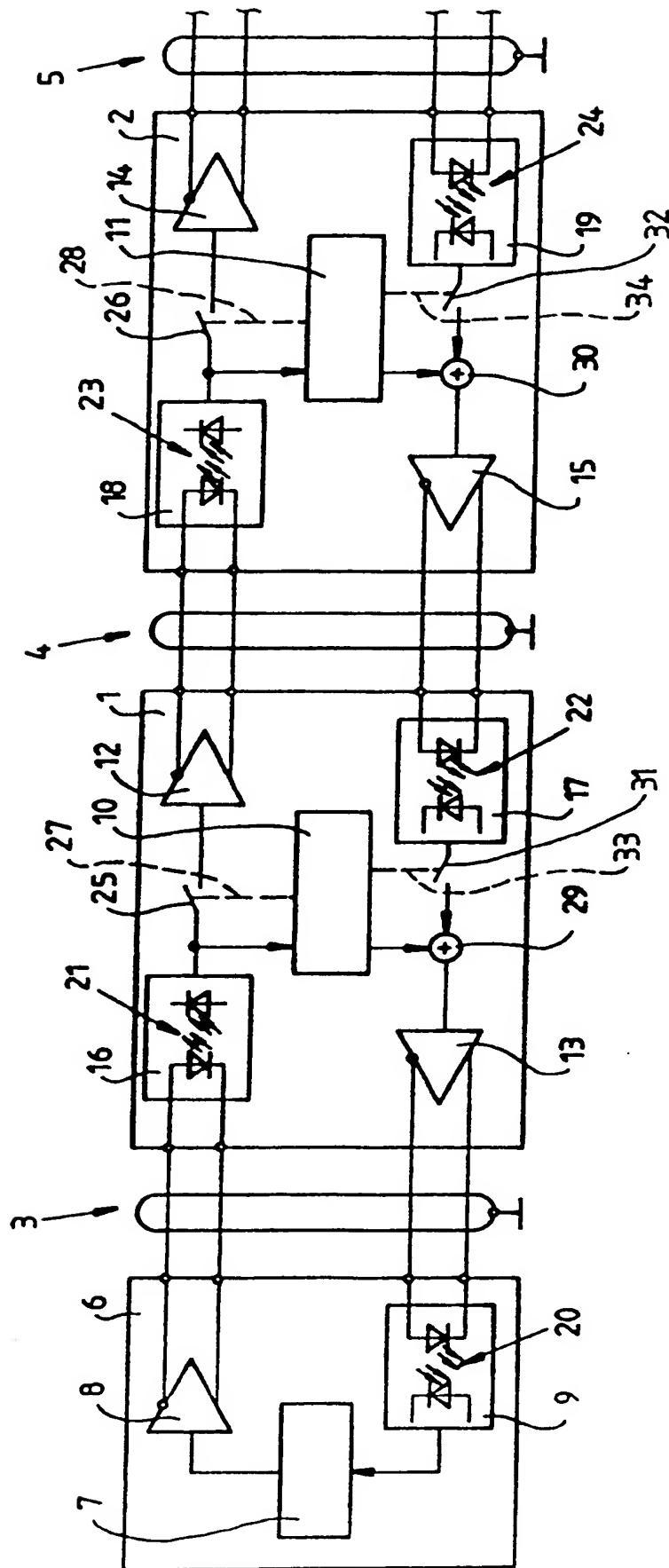

Fig.1

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Fig.1

Fig.2

Method of and arrangement for configuring functional units in a
serial master-slave arrangement

The invention relates to a method and an arrangement for the
transfer of information or other signals between a plurality of
functional units cooperating in a master-slave configuration.

It is known to connect, for the transfer of information, a master
unit and at least one slave unit to a common bus system in order
to transfer information. For this purpose specific circuits
controlling the transfer of data between master unit and slave
units are provided in said master unit and said slave units. The
fact that said specific circuits are expensive is
disadvantageous.

Furthermore, it is known to provide a master unit with a
plurality of serial interfaces making it possible to connect a
respective intelligent slave unit equipped with a computer to
each of said interfaces. For each additional slave unit to be
connected to the master unit an additional serial interface has
to be provided, said additional serial interface requires
material, is expensive and enlarges the volume occupied by the
master unit.

The possibility of connecting a plurality of slave units to a
serial interface is restricted by the performance of the
line-drive components in the master unit. To equip the master
unit with specific high-performance driver components is cost-
increasing because such components are not commercially available
and thus require individual developments, or because only small
quantities of said components are manufactured. Moreover, when
connecting in parallel a plurality of slave units to a serial
interface of the master unit, each slave unit has to be addressed
by means of hardware elements by, for example, providing a number
of switches in the slave unit so as to form a certain

configuration. According to this procedure it is, however, not possible to design similar slave units so as to be identical with respect to hardware and software so that said slave units could be easily exchanged for the purpose of addressing them, if necessary, which would guarantee low manufactoring costs and service costs.

It is also known to connect a plurality of slave units in series by means of data-transfer lines, a slave unit located at the end of the serial arrangement being connected to a master unit. The master unit features one serial input/output unit, whereas the slave unit has two serial input/output units. With these solutions, too, the slave units are addressed by means of hardware elements, i.e. switches or solder straps, having the aforementioned disadvantages.

It is the object of the invention to develop an arrangement for the transfer of information or other signals, said arrangement permitting the linking and addressing of a plurality of slave units connected in series to a master unit easily and at low-cost.

According to the invention this object is achieved in that in an arrangement in which a plurality of slave units of a maste-slave configuration is connected in series, that the slave units are each equipped with two pairs of input/output units and a digital computer, an electronic switch being provided between a receiving unit located in a direction coming from the master unit and a neighbouring slave unit located towards said master unit but more remote remote therefrom, the control input of said switch being connected to the digital computer. Furthermore, the invention consists in that each slave unit is provided with an electronic signal-summing element, a first input of said electronic signal-summing element is connected to the digital computer, preferably via an interface circuit, and that a second input of said electronic element is connected to a receiving section of the

input/output unit receiving signals from the aforementioned
neighbouring slave unit which is provided more remote from the
master unit. Due to the summing element only the active signal of
the respective digital computer or the neighbouring slave unit is
transmitted at the output of said slave unit in direction of the
master unit. The electronic switch and the summing element may be
set up of different logical elements. For example, the switch may
be an AND element, and the summing element may be an exclusive OR
element.

The invention is to be explained in greater detail with reference
to a specimen embodiment.

Fig. 1 is a schematic view of the inventive arrangement, and

Fig. 2 shows a specimen embodiment of a slave unit.

As shown in Fig. 1 a plurality of similar slave units 1, 2 are
connected in series by means of multi-core cables 3, 4 , 5, the
slave unit 1 located at the end being connected to a master unit
6. Said master unit 6 comprises a digital computer 7 as well as
an output unit 8 and an input unit 9, said output unit and said
input unit each being connected to the digital computer 7. The
slave units 1, 2 each comprise further digital computers 10, 11,
two output units 12, 13, 14, 15 and two input units 16, 17, 18,
19. Via cable 3 the ouput unit 8 is connected to the input unit
16, and the output unit 13 is connected to the input unit 9. The
cable 4 provides a connection betweeen the output unit 12 and the
input unit 18 and between the output unit 15 and the input unit
17. By means of cable 5 the output unit 14 and the input unit 19
are connected to further input/output units (not illustrated) of
further slave units. With respect to the galvanic separation the
input units 9, 16, 17, 18, 19 comprise optocouplers 20, 21, 22,
23, 24 the LEDs of which are each connected to two cores of the
cables 3, 4, 5. The slave units 1, 2 comprise electronic switches
25, 26 to interrupt the connection between the input units 16, 18

and the output units 12, 14. The control inputs of the switches
25, 26 have a respective connection 27, 28 with respect to the
digital computers 10, 11. Furthermore, the slave units 1, 2
comprise summing elements 29, 30, the first summing inputs of
said summing elements are connected to the digital computers 10,
11, and the second summing inputs of said summing elements are
connected to the outputs of the input units 17, 19, whereas the
summing ouputs of said summing elements are connected to the
inputs of the output units 13, 15.

The inventive method may be implemented by means of this
arrangement as described hereinafter: Due to the fact that master
unit 6 and slave units 1, 2 are connected in series, each slave
unit 1, 2 comprises two interfaces each of which is suitable for
the transfer of signals to and from the slave unit 1, 2 and to
and from the master unit 6 respectively. The digital signals
entering the input units 9, 16, 18 are processed and supplied to
the respective digital computer 7, 10, 11 for evaluation.
Depending on the fact as to whether the switch 25, 26 is closed,
the digitized signals are transmitted, via the output unit 12, 14
of the respective slave unit 1, 2, to the following slave unit 2
connected. If all switches 25, 26 are closed, a signal
transmitted by the master unit 6 may be received by all slave
units 1, 2 connected. Vice versa, a signal transmitted by any
slave unit 1, 2 may be supplied to the master unit 6, provided
the digital computer 10, 11 does not produce any signal at the
summing input of the respective summing element 29, 30 so that
the signal transmitted by a slave unit 1, 2 in direction of the
master unit 6 may pass in an unchanged manner the summing
elements 29, 30 in the slave units 1, 2 located on the signal
path. This may be achieved by keeping strictly to the
master-slave principle, i.e. that the respective slave unit 1, 2
only transmits signals if prompted by the master unit 6 to do so.
The digital computers 10, 11 of the slave units 1, 2 are
programmed such - or, in other words, the hardware is designed
such - that they are able to recognize a sychronizing sequence

among the flow of data coming from the master unit 6 or the
preceding slave unit 1 and to receive a data set. Preferably, in
each data set said synchronizing sequence is directly followed by
an address byte for addressing a slave unit 1, 2. Via the digital
computers 10, 11 all slave units 1, 2 check as to whether said
address byte corresponds to the respective address. If there is
no correspondence, the data reception is interrupted until the
next synchronizing sequence. In the case of an address
correspondence, the respective slave unit starts to process the
data. The slave units 1, 2 have an identical list address defined
by the hardware. Furthermore, via said data set, an individual
address may be assigned to each slave unit 1, 2.

With respect to initialization of and address allocation to a
slave unit 1, 2 the master unit 6 transmits a command to open the
switch 25, 26, having been closed beforehand, by means of the
list address. Thus, all slave units 1, 2 prevent that the signal
is supplied to the neighbouring slave units 1, 2. Upon this
command the slave untis 1, 2 do not transmit a reply in direction
of the master unit 6. In a further step the master unit 6
transmits a first command to individually allocate addresses by
means of the list address. Due to the switches being open, only
the first slave unit 1 directly connected to the master unit 6
receives said command. The digital computer 10 stores the address
allocation and, via the summing element 29 and the output unit
13, supplies a defined reply to the master unit 6 that the
individual address has been allocated. Furthermore, via the
connection 27, the digital computer 10 causes the switch 25 to be
closed.

The master unit 6 checks the defined reply and causes a
re-initialization, if the reply is not correct. If the reply is
correct, and if not all slave units 1, 2 stored in the master
unit 6 have yet been initialized, a further command for
individual address allocation by means of the list address is
supplied, said command being received by the slave unit 2 which

does not yet have an individual address. The initializing is repeated for each slave unit 2 according to the initialization of the first slave unit 1. The initialization is completed, if all slave units 1, 2 have stored the individual addresses and the slave units 1, 2 have successively transmitted a correct reply to the master unit 6.

In all cases in which, with respect to the transfer of data involving a slave unit 1, 2, a master unit 6 reports an error which could not be eliminated although the commands have been repeated several times, the connection in the slave units 1, 2 has to be set up again by the master unit 6.

According to the modification of the invention shown in Fig. 2 a respective further electronic switch 31, 32 is provided between the second summing input of the respective summing element 29, 30 and the input units 17, 19, the control input of said switch features a connection 33, 34 to the digital computers 10, 11. Thus, interferences can be suppressed by the fact that several slave units 1, 2 transmit signals simultaneously. While the slave unit transmits signals itself, a reply of the slave unit 1, 2 being transmitted in direction of the master unit 6 could prevent the summing of signals in the summing elements 29, 30 of the slave units 1, 2 being located more remote from the master unit 6. Thus, the slave unit 1, 2 nearest to the master unit has top priority.

C L A I M S

1. Method of configuring functional units in a serial
    master-slave arrangement,
    said functional units being provided for the bidirectional
    transfer of digital data between a master unit and a
    respective slave unit,
    method in which the master unit allocates a respective
    address to each slave unit which, when being in a
    non-configured condition, has no individual address,
    characterized
    by processing the following method steps:

    a) a record A is transmitted from the master unit to a list
        address, said record causing a switch to be opened in each
        of the slave units, said switch interrupting the transfer to
        the neighbouring slave units and resetting the memory for an
        individual address in each slave unit;

    b) a further record B is transmitted from the master unit to
        the list address, said record allocating an individual
        address, determined by the master unit and included in the
        record B, to each of the receiving slave units, if in the
        slave unit the memory for the individual address is still in
        its reset condition,

    c) upon allocation of the individual address the respective
        slave unit acknowledges said allocation by transmitting an
        acknowledgement record to the master unit, and said switch
        is closed;

    d) upon receipt of the acknowledgement record the master unit
        transmits a further record with a further individual address
        to the list address;

    e) the method steps b) through d) are repeated until a
        respective individual address has been allocated to each
        slave unit; and

    f) if an acknowledgement record transmitted in method step c)
        has been received by the master unit incorrectly or not at

all method steps a) through e) are repeated until the
acknowledgement signal sent by each of the slave units has
been correctly received by the master unit.

2.   Arrangement for configuring functional units in a
     master-slave arrangement,
     comprising a master unit having a digital computer and an
     input/output unit,
     and comprising a plurality of slave units each having a
     digital computer and two input/output units,
     whereby the master unit is connected to a first slave unit,
     and the slave units are connected to each other in series
     via the input/output units and data-transfer lines,
     characterized in
     - that in each slave unit (1, 2) there is provided an
       electronic switch (25, 26) for blocking the transfer of data
       between a receiving section (16, 18) - receiving information
       or signals from the direction of the master unit (6) - of
       the input/output unit and a transmitting section (12, 14) of
       the input/output unit driving information or signals in
       direction of neighbouring slave units (2), and
     - that in each slave unit (1, 2) there is provided an
       electronic summing element (29, 30),
       a first input of said summing element being connected to the
       digital computer (7), and a second input of said summing
       element being connected to a receiving section (17, 19) of
       the input/output unit receiving the signals from the
       neighbouring slave unit (2) provided more remote from the
       master unit (6), and
     - the output of said summing element being connected to a
       transmitting section (13, 15) of the input/output unit
       connected in direction of the master unit (6).

3.   Arrangement according to Claim 1,
     characterized in
     that between summing element (29, 30) and receiving section
     (17, 19) there is provided a further electronic switch (31,
     32) the control input of which has a connection (33, 34) to
     the digital computer (10, 11).

LIST OF REFERENCE NUMERALS

1, 2	slave unit
3, 4, 5	cable
6	master unit
7	digital computer
8	output unit
9	input unit
10, 11	digital computer
12, 13, 14, 15	output unit
16, 17, 18, 19	inputunit
20, 21, 22, 23, 24	optocoupler
25, 26	switch
27, 28	connection
29, 30	summing element
31, 32	switch
33, 34	connection

Patents Act 1977 **Examiner's report to the Comptroller under Section 17** **(the Search report)**	**Application number** GB 9502918.7

Relevant Technical Fields (i) UK Cl (Ed.N) H4P PPG, PPBC (ii) Int Cl (Ed.6) H04L 12/40, 12/12; G06F 12/06; H04Q 9/14	**Search Examiner** MR J P COULES
	Date of completion of Search 26 APRIL 1995
Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii)	**Documents considered relevant** **following a search in respect of** **Claims :-** 1-3

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&:   Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages	Relevant to claim(s)
X	EP 0281534 A2 (INSINOORITOIMISTO BERTEL EKENGREN OY) see whole document	1 and 2
A	US 4723241 (US PHILIPS CORP) see whole document	1 and 2

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